

**What Is Claimed Is:**

- 1        1.        A method for switching packets in a passive optical network which  
2        includes a central node and at least one remote node, the method comprising:  
3                receiving a packet at the central node;  
4                obtaining a first set of results by performing a first lookup based on a first  
5        set of values derived from the packet;  
6                obtaining a second set of results by performing a second lookup based on a  
7        second set of values derived from the packet;  
8                producing a merged value by merging the first set of results and the second  
9        set of results;  
10                obtaining a subsequent result by performing a subsequent lookup with the  
11        merged value; and  
12                if the packet is a downstream packet,  
13                        deriving a logical identifier corresponding to one or more remote  
14        nodes from the subsequent result,  
15                incorporating the logical identifier into the packet, and  
16                transmitting the packet to one or more remote nodes.
  
- 1        2.        The method of claim 1, wherein the first lookup involves directly  
2        addressing one or more entries of a direct-search table by offsetting one or more  
3        base addresses based on the first set of values.
  
- 1        3.        The method of claim 2, wherein the direct-search table is divided  
2        into a number of sub-tables, each of which starts at a corresponding base address;  
3                wherein a subset of the number of sub-tables are used if the packet is an  
4        upstream packet; and

5                   wherein a subset of the number of sub-tables are used if the packet is a  
6 downstream packet.

1                   4.        The method of claim 3, wherein the first set of values includes a  
2 virtual local area network (VLAN) identifier of the packet.

1                   5.        The method of claim 1, wherein the second lookup involves  
2 linearly searching one or more linear-search tables based on the second set of  
3 values; and wherein the second set of values includes a number of bits extracted  
4 from the packet.

1                   6.        The method of claim 1, further comprising producing a third set of  
2 results by performing a third lookup based on a third set of values derived from  
3 the packet; and wherein producing the merged value involves merging the first,  
4 second, and third sets of results.

1                   7.        The method of claim 6, wherein the third lookup involves a binary  
2 search through a working binary-search table based on the third set of values.

1                   8.        The method of claim 6, wherein if the packet is a downstream  
2 packet, the third set of values includes a destination media access control (MAC)  
3 address of the packet; and

4                   wherein if the packet is an upstream packet, the third set of values includes  
5 a source MAC address of the packet.

1           9.       The method of claim 8, wherein if the packet is an upstream packet  
2 and if the binary-search table does not contain an entry corresponding to the  
3 packet's source MAC address, the method further comprises:

4           inserting a new entry into the working binary-search table based on the  
5 packet's source MAC address;

6           wherein the key of the new entry is derived from the packet's source MAC  
7 address.

1           10.      The method of claim 9, wherein if there is no space left in the  
2 working binary-search table for inserting the new entry, the method further  
3 comprises:

4           populating a shadow binary-search table with existing entries in the  
5 working binary-search table and the new entry, wherein the distribution of entries  
6 in the shadow binary-search table is more balanced than the working binary-  
7 search table;

8           converting the shadow binary-search table to an updated working binary-  
9 search table; and

10          converting the prior working binary-search table to a shadow binary-search  
11 table.

1           11.      The method of claim 6, wherein each of the first, second, and third  
2 sets of results includes:

3           a discard value;

4           a quality of service (QoS) value;

5           a destination value; and

6           three priority numbers setting the priority of the discard value, QoS value,  
7 and destination value, respectively;

8           wherein the QoS value and destination value are used to produce the  
9       merged value; and

10          wherein the discard value indicates whether the merged value should be  
11       discarded.

1           12.       The method of claim 11, wherein merging the first, second, and  
2       third sets of results to produce the merged value involves:

3           selecting the discard value, QoS value, and destination value with the  
4       highest priority among all the results;

5           if there is a tie in the priority associated with a value, performing a logical  
6       “OR” operation among the tying values and setting the corresponding value to the  
7       “OR” result;

8           combining the selected QoS value and destination value to produce the  
9       merged value; and

10          if the selected discard field indicates that the merged value should be  
11       discarded, discarding the merged value.

1           13.       The method of claim 1, wherein the subsequent result includes a  
2       queue index which specifies a queue where the packet can be stored before the  
3       packet is transmitted.

1           14.       The method of claim 1, wherein the subsequent result includes a  
2       logical identifier which specifies one or more remote nodes to which the packet is  
3       destined if the packet is a downstream packet.

1           15.       The method of claim 1, wherein the subsequent result includes a  
2       VLAN identifier.

1        16. An apparatus for switching packets in a passive optical network  
2 which includes a central node and at least one remote node, the apparatus  
3 comprising:

4            a receiving mechanism configured to receive a packet at the central node;  
5            a first lookup mechanism configured to obtain a first set of results by  
6 performing a first lookup based on a first set of values derived from the packet;  
7            a second lookup mechanism configured to obtain a second set of results by  
8 performing a second lookup based on a second set of values derived from the  
9 packet;  
10           a merging mechanism configured to produce a merged value by merging  
11 the first set of results and the second set of results;  
12           a subsequent lookup mechanism configured to obtain a subsequent result  
13 by performing a subsequent lookup with the merged value; and  
14           a transmission mechanism; wherein if the packet is a downstream packet,  
15 the transmission mechanism is configured to:  
16            derive a logical identifier corresponding to one or more remote  
17 nodes from the subsequent result;  
18            incorporate the logical identifier into the packet; and  
19            transmit the packet to one or more remote nodes.

1        17. The apparatus of claim 16, further comprising a direct-search table;  
2 wherein the first lookup mechanism is further configured to directly address one  
3 or more entries of the direct-search table by offsetting one or more base addresses  
4 based on the first set of values.

1        18.     The apparatus of claim 17, wherein the direct-search table is  
2 divided into a number of sub-tables, each of which starts at a corresponding base  
3 address;

4        wherein a subset of the number of sub-tables are used if the packet is an  
5 upstream packet; and

6        wherein a subset of the number of sub-tables are used if the packet is a  
7 downstream packet.

1        19.     The apparatus of claim 18, wherein the first set of values includes a  
2 VLAN identifier of the packet.

1        20.     The apparatus of claim 16, further comprising one or more linear-  
2 search tables;

3        wherein the second lookup mechanism is further configured to linearly  
4 search the one or more linear-search tables based on the second set of values; and

5        wherein the second set of values includes a number of bits extracted from  
6 the packet.

1        21.     The apparatus of claim 16, further comprising a third lookup  
2 mechanism configured to produce a third set of results by performing a third  
3 lookup based on a third set of values derived from the packet; and

4        wherein the merging mechanism is further configured to merge the first,  
5 second, and third sets of results

1        22.     The apparatus of claim 21, further comprising a working binary-  
2 search table; and

3           wherein the third lookup mechanism is further configured to perform a  
4   binary search through the working binary-search table based on the third set of  
5   values.

1           23.       The apparatus of claim 21, wherein if the packet is a downstream  
2   packet, the third set of values includes a destination media access control (MAC)  
3   address of the packet; and

4           wherein if the packet is an upstream packet, the third set of values includes  
5   a source MAC address of the packet.

1           24.       The apparatus of claim 23, wherein if the packet is an upstream  
2   packet and if the binary-search table does not contain an entry corresponding to  
3   the packet's source MAC address, the third lookup mechanism is further  
4   configured to:

5           insert a new entry into the working binary-search table based on the  
6   packet's source MAC address;

7           wherein the key of the new entry is derived from the packet's source MAC  
8   address.

1           25.       The apparatus of claim 24, wherein if there is no space left in the  
2   working binary-search table for inserting the new entry, the third lookup  
3   mechanism is further configured to:

4           populate a shadow binary-search table with existing entries in the working  
5   binary-search table and the new entry, wherein the distribution of entries in the  
6   shadow binary-search table is more balanced than the working binary-search  
7   table;

8 convert the shadow binary-search table to an updated working binary-  
9 search table; and  
10 convert the prior working binary-search table to a shadow binary-search  
11 table.

1 26. The apparatus of claim 21, wherein each of the first, second, and  
2 third sets of results includes:

3 a discard value;  
4 a quality of service (QoS) value;  
5 a destination value; and  
6 three priority numbers setting the priority of the discard value, QoS value,  
7 and destination value, respectively;

8 wherein the QoS value and destination value are used to produce the  
9 merged value; and

10 wherein the discard value indicates whether the merged value should be  
11 discarded.

1 27. The apparatus of claim 26, wherein the merging mechanism is  
2 further configured to:

3 select the discard value, QoS value, and destination value with the highest  
4 priority among all the results;

5 if there is a tie in the priority associated with a value, perform a logical  
6 “OR” operation among the tying values and set the corresponding value to the  
7 “OR” result;

8 combine the selected QoS value and destination value to produce the  
9 merged value; and

10 if the selected discard field indicates that the merged value should be  
11 discarded, discard the merged value.

1 28. The apparatus of claim 16, wherein the subsequent result includes  
2 a queue index which specifies a queue where the packet can be stored before the  
3 packet is transmitted.

1 29. The apparatus of claim 16, wherein the subsequent result includes  
2 a logical identifier which specifies one or more remote nodes to which the packet  
3 is destined if the packet is a downstream packet.

1 30. The apparatus of claim 16, wherein the subsequent result includes  
2 a VLAN identifier.

1 31. A computer-readable storage medium storing instructions that  
2 when executed caused by a computer cause the computer to perform a method for  
3 switching packets in a passive optical network which includes a central node and  
4 at least one remote node, the method comprising:

5 receiving a packet at the central node;

6 obtaining a first set of results by performing a first lookup based on a first  
7 set of values derived from the packet;

8 obtaining a second set of results by performing a second lookup based on a  
9 second set of values derived from the packet;

10 producing a merged value by merging the first set of results and the second  
11 set of results;

12 obtaining a subsequent result by performing a subsequent lookup with the  
13 merged value; and

14           if the packet is a downstream packet,  
15                   deriving a logical identifier corresponding to one or more remote  
16                   nodes from the subsequent result,  
17                   incorporating the logical identifier into the packet, and  
18                   transmitting the packet to one or more remote nodes.

1           32.       The computer-readable storage medium of claim 31, wherein the  
2       first lookup involves directly addressing one or more entries of a direct-search  
3       table by offsetting one or more base addresses based on the first set of values.

1           33.       The computer-readable storage medium of claim 32, wherein the  
2       direct-search table is divided into a number of sub-tables, each of which starts at a  
3       corresponding base address;

4                   wherein a subset of the number of sub-tables are used if the packet is an  
5       upstream packet; and

6                   wherein a subset of the number of sub-tables are used if the packet is a  
7       downstream packet.

1           34.       The computer-readable storage medium of claim 33, wherein the  
2       first set of values includes a VLAN identifier of the packet.

1           35.       The computer-readable storage medium of claim 31, wherein the  
2       second lookup involves linearly searching one or more linear-search tables based  
3       on the second set of values; and wherein the second set of values includes a  
4       number of bits extracted from the packet.

1           36.    The computer-readable storage medium of claim 31, wherein the  
2 method further comprises producing a third set of results by performing a third  
3 lookup based on a third set of values derived from the packet; and wherein  
4 producing the merged value involves merging the first, second, and third sets of  
5 results.

1           37.    The computer-readable storage medium of claim 36, wherein the  
2 third lookup involves a binary search through a working binary-search table based  
3 on the third set of values.

1           38.    The computer-readable storage medium of claim 36, wherein if the  
2 packet is a downstream packet, the third set of values includes a destination media  
3 access control (MAC) address of the packet; and  
4           wherein if the packet is an upstream packet, the third set of values includes  
5 a source MAC address of the packet.

1           39.    The computer-readable storage medium of claim 38, wherein if the  
2 packet is an upstream packet and if the binary-search table does not contain an  
3 entry corresponding to the packet's source MAC address, the method further  
4 comprises:

5           inserting a new entry into the working binary-search table based on the  
6 packet's source MAC address;  
7           wherein the key of the new entry is derived from the packet's source MAC  
8 address.

1           40.     The computer-readable storage medium of claim 39, wherein if  
2 there is no space left in the working binary-search table for inserting the new  
3 entry, the method further comprises:

4           populating a shadow binary-search table with existing entries in the  
5 working binary-search table and the new entry, wherein the distribution of entries  
6 in the shadow binary-search table is more balanced than the working binary-  
7 search table;

8           converting the shadow binary-search table to an updated working binary-  
9 search table; and

10          converting the prior working binary-search table to a shadow binary-search  
11 table.

1           41.     The computer-readable storage medium of claim 36, wherein each  
2 of the first, second, and third sets of results includes:

3           a discard value;

4           a quality of service (QoS) value;

5           a destination value; and

6           three priority numbers setting the priority of the discard value, QoS value,  
7 and destination value, respectively;

8           wherein the QoS value and destination value are used to produce the  
9 merged value; and

10          wherein the discard value indicates whether the merged value should be  
11 discarded.

1           42.     The computer-readable storage medium of claim 41, wherein  
2 merging the first, second, and third sets of results to produce the merged value  
3 involves:

4           selecting the discard value, QoS value, and destination value with the  
5       highest priority among all the results;  
6           if there is a tie in the priority associated with a value, performing a logical  
7       “OR” operation among the tying values and setting the corresponding value to the  
8       “OR” result;  
9           combining the selected QoS value and destination value to produce the  
10      merged value; and  
11          if the selected discard field indicates that the merged value should be  
12      discarded, discarding the merged value.

1           43.       The computer-readable storage medium of claim 31, wherein the  
2       subsequent result includes a queue index which specifies a queue where the  
3       packet can be stored before the packet is transmitted.

1           44.       The computer-readable storage medium of claim 31, wherein the  
2       subsequent result includes a logical identifier which specifies one or more remote  
3       nodes to which the packet is destined if the packet is a downstream packet.

1           45.       The computer-readable storage medium of claim 31, wherein the  
2       subsequent result includes a VLAN identifier.